Date:	December 16, 2010
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Subject:	Review of Selected Data Targets for General Electric Upper Hudson River Modeling System

Several data targets are being used for parameterization and evaluation of General Electric's (GE's) Upper Hudson River Modeling System (See Issues Memorandum issued by EPA's Model Evaluation Team dated December 13, 2010). This memo presents issues of concern for selected data targets that may affect the representation of the modeling system and results. The issues of concern discussed include:

- Initial conditions used in the long-term calibration,
- Comparison of near-field polychlorinated biphenyl (PCB) concentrations predicted by the model simulation to PCB concentrations measured in water samples collected in the near-field during Phase 1 dredging, and
- Analytical uncertainties in water column PCB data.

Initial Conditions in 1977 for Long-Term Calibration

As part of the calibration and validation process for its model, GE conducted a long-term simulation of PCB and sediment transport for the period from 1977 to 1999. For this simulation, GE used post-1999 side scan sonar, bulk density, and grain size distribution data to represent the initial conditions of the sediment bed. The use of such recent information to represent the 1977 sediment bed surface is not representative of the actual 1977 conditions due to disruption of the geomorphologic state of the system resulting from removal of the Fort Edward dam in 1973. Removal of the dam and subsequent flooding moved much of the accumulated PCB-contaminated sediments downstream.

Studies have shown that significant changes to the river's geomorphology may occur when a dam is removed. For example, removal of the Stronach Dam from the Pine River, located in Michigan, resulted in progressive headcutting of sediments in the former impoundment, extending upstream 3.89 km of the dam (Bryan et al. 2009). The Pine River study also reported that continuing changes in the river's geomorphology were evident for three years following removal, and that these changes are likely to continue for years to come. Therefore, it is likely that the current bathymetry and side scan sonar data do not represent bottom conditions as they were in1977, and uncertainties related to this assumption need to be assessed. In addition, the spatial representativeness of the 1977 sediment bed PCB concentrations also needs to be assessed.

Comparison of Model-Predicted PCB Concentrations to Measured PCB Concentrations in the Near-field During Phase 1 Dredging

The conceptual model for PCB and solids release during dredging assumed a one-to-one correspondence between solids release and PCB release at the dredge head. For the near-field release mechanism, a solids release of 1 percent was a better fit to the observation (see Figure 1). However, for dissolved phase PCBs, a 5 percent release was the better fit (see Figure 2). This indicates that the processes controlling PCB dynamics are more complex than the simple release of solids represented in the AQ model. The Peer Review Panel called for the formulation of a conceptual site model that encompasses all the mechanisms for PCB release, and the development of a new or updated model that can be used to project PCB fate and effects with a higher degree of confidence than is currently available. Other factors that affect near-field conditions include, but are not limited to: PCBs in the form of non-aqueous phase liquid, boat traffic, backfill, and open CUs upstream of the study area. Therefore, during the first year of Phase 2, adequate data needs to be collected in the near-field to ensure that the model is well constrained, and that the mechanisms for PCB fate and transport are better understood and formulated so that the model can be appropriately calibrated.

Uncertainty in PCB Analytical data

There are two issues associated with analytical results available for comparison of the observed and predicted PCB concentrations. These issues may affect both model calibration and long-term simulation. The first concern relates to use of the Aroclor method in historical analysis to represent Total and Tri+ PCBs. When conducting the long-term simulations, the model data comparison relies on historical data collected by the United States Geological Survey (USGS) and the New York Department of Environmental Conservation. Previous analysis performed by EPA during the Hudson River Data Reassessment determined that the sum of Aroclors for the USGS data and some of the historical (pre-1990s) data is equivalent to Tri+ PCBs. In addition, there are data quality issues with the USGS water column PCB concentrations, including the presence of non-detects in 1999 and 2000 at Waterford, when detected values were reported prior to and following these years. It is unclear how the long-term simulation addressed this issue and whether the model comparison of loads and concentrations has taken this into consideration.

The second issue of concern is associated with the correction factor (CF) that GE has applied to water column data analyzed using the modified Green Bay Method (mGBM). The mGBM method yields analytical results in the form of peaks rather than individual PCB congeners (which are also represented by BZ numbers). In some instances, a mGBM peak is composed of a single PCB congener. However, in the majority of cases, each mGBM peak is composed of multiple, co-eluting congeners. For one particular peak reported by the mGBM, Peak 5, which represents two congeners (BZ4 and BZ10), the ratio of BZ4 to BZ10 (BZ4:BZ10) in Hudson River sediments is different than the ratio of BZ4:BZ10 in the calibration standards used during the analysis. To account for this difference, correction factors were developed which would quantitate the concentrations of BZ4 and BZ10 based on a defined concentration relationship. Correction factors were calculated based on water samples collected in 1997, 2003, and 2009.

Historically, this BZ4:BZ10 ratio varied consistently from 3:1 to 4:1 in samples obtained during 1997, 2003, and 2009. In addition, the CFs used to capture this difference and applied to produce accurate sample concentrations were also consistent from 1997 to 2003, with respective values of 0.68 and 0.61. These factors correspond to BZ4 mass fractions of 0.778 (1997) and 0.788 (2003), the difference between which is only 1.3 percent. The 2009 data yield a BZ4 mass fraction of 0.782. Statistically, all of these factors are within error or one another, indicating no measureable change in the makeup of this peak. However, despite no change in the BZ4:BZ10 concentration ratio in water samples obtained in 2009, the CF applied to the 2009 data was increased to 0.81. Thus, the results suggest that a compositional change of these two congeners in river samples, possibly as a result of actions taken (dredging) would not be observed, and therefore should not result in a significantly different CF.

As a result of our findings, serious issues have been raised regarding the mGBM itself and whether the application of a correction factor is appropriate. The application of this revised correction factor has not been accepted for use by EPA (please see letters to GE dated March 19, 2010 and October 13, 2010). EPA has requested additional analysis of the issue which is yet to be conducted by GE. Application of these correction factors to the analytical data may affect the model calibration, dredge simulation, and long-term forecasts. For example, since 2003, it is not known whether the factors changed before 2009 when the checks were done. If the factors did change before 2009, then they may have an effect on the Baseline Monitoring data.

Reference

Bryan A. Burroughs, Daniel B. Hayes, Kristi D. Klomp, Jonathan F. Hansen and Jessica Mistak. Effects of Stronach Dam removal on fluvial geomorphology in the Pine River, Michigan, United States. **Geomorphology,** *110*, Issues 3-4, Pages 96-107, **2009.**

PCB Release Mechanism:

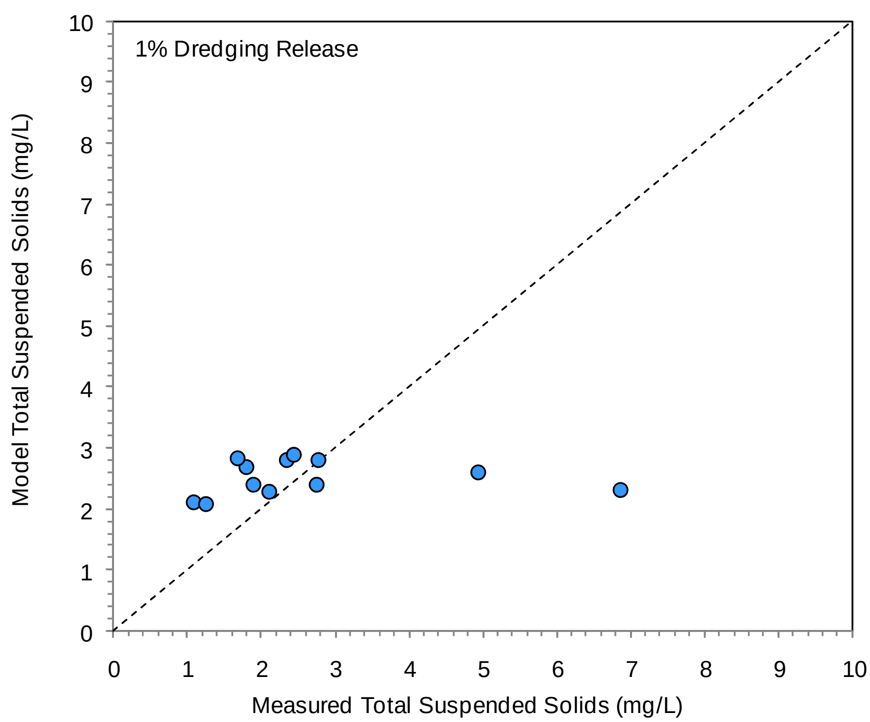

Figure 1. Model Total Suspended Solids vs. Measure Total Suspended Solids (Near-Field PCB Release Mechanism)

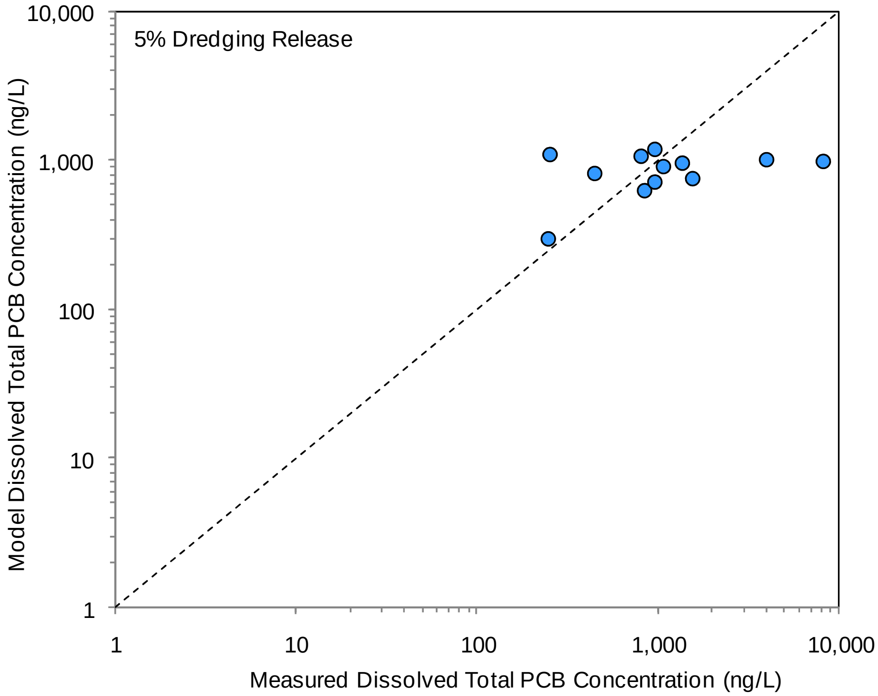

Figure 2. Model Dissolved Total PCB Concentration vs. Measure Dissolved Total PCB Concentration (Near-Field PCB Release Mechanism)